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Biodiversity, climate change and poverty: exploring the links

An IIED Briefing

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Biodiversity — the variety of all life, from genes and species to ecosystems — is intimately linked to Earth's climate and, inevitably, to climate change. Biodiversity and poverty are also inextricably connected. For instance, changes to natural ecosystems influence both climate change and people's ability to cope with some of its damaging impacts. And in their turn climate change, as well as people's responses to it, affect biodiversity. Unpicking all these strands clearly shows that conserving and managing biodiversity can help natural systems and vulnerable people cope with a shifting global climate. Yet compared to activities such as forest conservation and afforestation — widely noted as a way of sequestering carbon and cutting greenhouse gas emissions — biodiversity conservation is a neglected area. That must change: urgent support is needed for local solutions to biodiversity loss that provide benefits on all counts.

KEY POINTS:

- **Biodiversity is key to how well people can adapt to climate change, how effectively landscapes absorb and store carbon, and how effective vegetation and ecosystems are in reducing the adverse impacts of climate change.**
- **Large-scale projects such as protecting substantial areas of forest can conserve biodiversity and capture carbon, but the poor will need to be involved in any planning and decision-making.**
- **Priority should be given to local initiatives that use local knowledge and approaches to deliver multiple benefits, such as traditional farming systems that conserve genetic and ecosystem diversity, sustain local adaptation, sequester carbon and reduce poverty.**

The links between climate change and biodiversity

In its Fourth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) states with 'very high confidence' that human activities since 1750 have caused global warming. For the next two decades, says the IPCC, about 0.2 °C of warming per decade is projected. Among the many knock-on effects are a sea level rise of more than 50 centimetres by 2100. It is also likely that some 20 to 30 per cent of plant and animal species assessed will be at greater risk of extinction if the rise in global average temperatures exceeds 2-3 °C.[1, 2]

Biodiversity, land use and climate change Changes to biodiversity and natural systems are likely to have a major influence on the global climate. Land use changes leading to habitat and thus biodiversity losses can also boost greenhouse gas emissions. For instance forests, which are vital carbon sinks, release carbon dioxide (CO_2) into the atmosphere when cut down or burnt. Land use changes, particularly deforestation in tropical regions — where forests tend to be very rich in biodiversity — are responsible for roughly 18 per cent of human-driven CO_2 emissions.[3]

Peatlands hold about a third of the carbon contained in soil worldwide, and greenhouse gases are released every time they are burnt, drained or converted to cropland. Many peatlands are important biodiversity reservoirs or stopover points for migratory species. So while the measurable effects of actual biodiversity loss on climate change may be highly variable, it is far more certain that conserving biodiversity will help in mitigating climate change.

Using biodiversity to cope with climate change impacts

Scientists agree that even if greenhouse gas emissions were to stabilise — an unlikely scenario, given inertia on the part of governments and the public — global warming and sea level rise will persist for centuries. This is down to the timescales associated with climate processes and feedback. So the need to adapt to climate change impacts is inevitable. It is also already happening across the globe. Many people are using natural resources and biodiversity, including genetic diversity, as part of the adaptation process. For instance, wild relatives of food crops can be used to breed new varieties that can cope with changing conditions. In India, for instance, some farmers are accessing different crop varieties through traditional exchange systems, developing new varieties, and adapting farming practices to cope with hotter temperatures, pest infestations and disease (see Box 1).

In many regions of the developing world, the rural poor already rely heavily on wild food sources and medicinal

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Box 1 Swap shop: agro-biodiversity and traditional knowledge in India

It may be known in the North for tea, but Darjeeling district in West Bengal, India, is rich in traditional rice varieties. Here, seed purity is maintained through exchanges within and between villages. Women farmers adapt to changing conditions by procuring seeds of different varieties through traditional practices of seed saving, exchanges and networks. For example, a villager growing rice at 1200 metres obtained a different variety suited to higher temperatures from a villager at 750 metres. To cope with water shortages, farmers engaged in wet rice cultivation are trying to get native seeds suitable for dry paddy fields from others in neighbouring Sikkim.

Farmers in the region are also adapting agricultural practices and developing new varieties. One farmer is planting ginger a little later than usual to help tackle pest infestation. Another has used a wild relative of cardamom to breed a new, disease-resistant variety — which is such a success, it has attracted support from the state government for sale to neighbouring regions.

Traditional farming systems and farmers' innovations are clearly at the cutting edge in adaptation to climate change. While scientists and policymakers work to find solutions, local farmers have already amassed considerable experience of how to cope, based on their observation and experimentation in the field.

Source: Ruchi Pant, Ecoserve, India

plants to supplement diets and maintain health. Some species are used on a daily basis; others are important during periods of drought or stress. In times of need some farmers may plant crop varieties resistant to floods, drought or saline conditions. A diverse genetic base is key to providing varieties from which such characteristics can be developed. As Box 1 shows, traditional farming systems actively sustain rich genetic diversity — a role more important than ever, as modern farming practices such as monocultures have significantly reduced diversity within species.

Conserved ecosystems offer many other services vital for adapting to climate change. Wetlands are important reservoirs for floodwater. Vegetation such as hedges protects agricultural land from excessive water or wind erosion in times of heavy rainfall or drought. And by preventing erosion on hillsides, vegetation also reduces the risk of landslides when rain comes in heavy bursts. Watersheds with intact plant cover slow the movement of rainfall to rivers and so reduce flood risks downstream. Mangroves are well-known coastal buffers, reducing the strength of waves before they reach the shore and so protecting against cyclone damage to coasts and seaside communities (see also Box 2).

How climate change affects biodiversity Climate change will have a number of impacts on biodiversity, from ecosystem to species level.[4] The most obvious is the effect that flooding, sea level rise and changes in temperature will have on ecosystem boundaries. As a result of these shifts in boundary, some ecosystems will expand into new areas, while others will become smaller. Habitats will change as rainfall and temperatures change, and some species will not be able to keep up, leading to a sharp increase in extinction rates.

The 2005 Millennium Ecosystem Assessment (MEA) estimates that by the end of this century, climate change will be the main driver of biodiversity loss. Along with predicting a higher risk of species extinctions, the IPCC says that temperature increases up to 3 °C are also very likely to trigger substantial changes in the structure and functioning of all ecosystems.[2]

The impacts of climate change on biodiversity will vary from region to region. The most rapid changes in climate are expected in the far north and south and in mountainous regions. These also happen to be the regions where species are more likely to be 'painted into a corner', with no alternative habitat to which they can migrate. Species with small populations, or populations restricted to small areas, are also especially vulnerable to any climatic shifts.

Higher water temperatures have already caused devastating losses of biodiversity in coral reefs. Global warming is also causing shifts in the reproductive cycles and growing seasons of certain species, which can in their turn affect how ecosystems function. The equilibrium of ecosystems can also be upset when, for example, insect pests previously unknown in the UK survive the warmer winters. Migrating species may be affected dramatically by any changes to stopover sites key to their survival, or when seasonal availability of food sources is no longer synchronised with migration times.

How responses to climate change affect biodiversity
The strategies used to counter climate change can also affect biodiversity adversely. Measures for reducing greenhouse gas emissions are one example. Some forms of renewable energy technology can lead to poor outcomes for biodiversity. Biofuel plantations may involve clearing areas of high biodiversity, such as tropical forests (leading to greenhouse gas emissions on top of biodiversity loss), and introduce monocultures of alien species and damaging agrochemicals. By 'drowning' land and disrupting river flows, large hydropower schemes can cause the loss of terrestrial and aquatic biodiversity and inhibit fish migration. Dammed water can also become a net emitter of greenhouse gases as submerged soils and vegetation decay and release CO_2 and methane.

Poorly located wind farms, on bird migration routes for example, can kill significant numbers of birds. By contrast, some renewable energy measures such as efficient stoves and biogas use can conserve carbon reservoirs and reduce pressure on forests. An increase in demand for freshwater, which is likely as the climate warms, could degrade wetlands, rivers and streams and so damage key ecosystem services.

The links between poverty, climate change and biodiversity

Poor people are disproportionately vulnerable to the loss of biodiversity and ecosystem services. And although they are responsible for emitting the lowest levels of greenhouse gases, they suffer most from the impacts of climate change. Recognising this, the United Nations Framework Convention on Climate Change (UNFCCC) asserts that there are 'common but differentiated responsibilities' for tackling climate change. But along with the Convention on Biological Diversity (CBD) and the Millennium Development Goals (MDGs), these agreements do not specify the strategies and methods to be used by parties to each agreement to meet their stated aims. While links between climate change, biodiversity and poverty are clear, and there is an obvious

imperative to support projects and activities that meet the objectives of all three agreements, in practice these tend to be thin on the ground. And in some cases, activities intended to meet the goals of one agreement may negatively affect the goals of another.

Geographic location is a key factor in the vulnerability of poor people and poor nations. Many of these countries lie in the regions most at risk from climate change (such as drought-prone sub-Saharan Africa); many of the poor may live in marginal areas such as floodplains or at the foot of unstable hillsides. Poor people also have the fewest choices available to them, and the lowest capacity — because of lack of resources and mobility, for example — to cope with climate change-related shocks such as cyclones.[5]

Poor countries and poor people also depend heavily on climate-sensitive sectors and natural resources. These include agriculture, fishing, water provision, grazing, timber and non-timber forest products such as food, medicine, tools, fuel, fodder and construction materials.

As the MEA points out, this dependence means the impact of climate and other environmental changes on biodiversity and ecosystem services poses a real threat to the livelihoods, food security and health of the poor. Women in the developing world are especially vulnerable, as they tend to rely more on natural resources than men. In dry parts of India, where wild products normally provide 14 to 23 per cent of income for the rural poor, drought pushes this figure up to 42 to 57 per cent.[6] Canada's Inuit people have already observed climate change-related reductions in the ringed seal population, their single most important source of food.[7]

Biodiversity conservation and the maintenance of ecosystem integrity are central to improving the ability of the poor to cope with climate change. Ecosystems with rich 'functional diversity'— that is, species that fill a variety of unique ecological roles — are more stable and may be better able to adapt to climate change than impoverished systems. A larger gene pool will facilitate the emergence of genotypes that are better adapted to shifts in climatic conditions.

Pro-poor, biodiversity-friendly adaptation

Coastal protection Sea walls and infrastructure designed to protect coastal areas from rising sea level and extreme weather events are often touted as a good means of adaptation to climate change. But these are expensive to build and maintain, and use large amounts of energy and concrete in the construction process, thereby increasing greenhouse gas emissions. Box 2 describes how, in Vietnam, the rehabilitation of coastal mangroves — havens for biodiversity — offers protection against storms that is as effective as that offered by concrete structures, while also acting as carbon sinks and enhancing local livelihoods.

Boosting agricultural and rangeland productivity
A common approach to coping with droughts or floods resulting from climate change is to both provide aid and attempt to increase agricultural production by using more intensive farming methods. But these moves tend to favour neither biodiversity nor the functional health of ecosystems.

Box 2 Shored up: mangrove rehabilitation in Vietnam

For decades in Vietnam, tropical cyclones have badly disrupted the livelihoods of people living near the coast. The risk of further damage is high, as climate change may increase the frequency and severity of tropical storms. But the rehabilitation of one type of coastal ecosystem — mangroves — offers a way of making communities near them less vulnerable to storms.

Mangrove wetlands provide physical protection from storms and sequester carbon. They are also a resource base for local livelihoods and income generation. Since 1994, the Vietnam Red Cross has worked with local communities to plant and protect mangrove forests in northern Vietnam. Nearly 12,000 hectares of mangroves have been planted, and the benefits have been staggering.

Although planting and protecting the mangroves cost approximately US$1.1 million, the project ultimately saved US$7.3 million a year in dyke maintenance. During the devastating Typhoon Wukong in 2000, the project areas remained unharmed while neighbouring provinces suffered huge losses in lives, property and livelihoods. The Vietnam Red Cross estimates that some 7750 families have benefited from mangrove rehabilitation. Family members can now earn additional income from selling the crabs, shrimp, molluscs and seaweed that thrive in the mangroves and increase the protein in their diets.
Source: International Federation of Red Cross and Red Crescent Societies

When Hurricane Mitch struck Honduras in October 1998, however, it was found that farms using conventional methods were less resilient to the erosion and runoff resulting from the heavy rainfall than farms using agroecological practices and materials. These included soil and water conservation, cover cropping to ensure land was never bare, integrated pest management, and reduced or zero grazing. The poorest groups suffered the greatest losses. This happened in part because with little access to credit, land titles and technical assistance, farmers have few incentives to invest in sustainable farming practices, which in turn has contributed to the removal of much protective plant cover.

Yet while farms using agroecological methods suffered less erosion, landslides affected all farms equally. Good management of the entire watershed is the only way to solve this problem. Conserving watershed vegetation increases water retention and availability in times of drought, decreases the risk of flash floods and landslides, and maintains plant cover which also acts as a carbon sink. But watersheds can cover vast areas and are often used or owned by a number of people with differing priorities. In this context, environmental education can help, as can payment mechanisms between up- and downstream land users.

In drought-prone areas, improved irrigation systems are often promoted as the best way to cope with reduced water availability. But in arid parts of Namibia, the markets generally support indigenous biodiversity production systems such as wildlife and native antelope management. In the large ecosystem of the Nama Karas, the rates of return for communal livestock such as cows and goats, freehold livestock and tourism (based on indigenous wildlife) are 5.5, 9.8 and 12.9 per cent respectively. These figures stand despite policy failures and market distortions driving down

the value of indigenous species and subsidising the use of non-native livestock.

Data from 2005 in these areas of Namibia suggest the natural resources and tourism sectors can out-perform returns from farming by a factor of two or more. And with a harsher future climate expected, the economic argument for shifting to production systems based on indigenous biodiversity is even stronger. A number of adaptations meet both aims. These include removing fences to provide open landscapes that support collaborative management systems, such as peace parks; and forming large combined estates out of neighbouring land, in which the landowners own shares.[8] Good governance and joint management are needed to ensure that benefits accruing from this kind of system reach poorer people — particularly those relying on common property resources — rather than just an elite.

Protected areas With biodiversity under threat from climate change, some are calling for the establishment of protected areas, as havens for species at risk, to receive renewed support.[9] Size is important: larger protected areas are likely to be more resilient in the face of climate change, as they provide a greater variety of conditions for a wider range of species. The proposed Greater Addo Elephant National Park in South Africa, for example, would include most of a river catchment, some 440,000 hectares of land area and 100,000 hectares of marine, and a huge range of ecosystems, altitudes, and land- and seascapes.

One of the advantages cited for the Greater Addo initiative is increased protection against climate change. With other well-managed protected areas, the park could play an important role in sequestering carbon as well as supporting sustainable natural resource use, local livelihoods and biodiversity conservation. Most protected areas struggle to be self-financing, however, so initiatives like these will demand public funding to support their management. It is also important to avoid any repeat of the preservationist practices and social injustices that accompanied the establishment of protected areas before the 1970s. Even today, some protected areas restrict communities living in and around them from accessing the natural resources they depend on for livelihoods. Goal 2.2 of the Convention on Biological Diversity work programme on protected areas aims to 'enhance and secure involvement of indigenous and local communities and relevant stakeholders'. Areas conserved by communities, where local institutions sustainably manage both wild biodiversity and traditional farming systems, can offer a more pro-poor approach than government-run protected areas.

While protected areas play an important role in conserving biodiversity, the knock-on effects of climate change may mean some smaller protected areas cease to provide suitable habitats for the species they were designed to conserve. Adaptation to a changing environment rarely features in the remit of protected area networks. Most biodiversity is also located outside protected areas, so there is a clear need to find ways to protect such biodiversity, while also involving and benefiting the people who rely on this land. This situation suggests the need for a broader approach to land management, where solutions that both conserve biodiversity and benefit local communities are supported. For example, limited grazing takes place in South Africa's Richtersveld National Park, allowing conservation activities to continue, but not at the expense of local livelihoods.[9]

Well-managed areas that cover a range of elevations, microclimates and ecosystems will be less vulnerable to climate change, as species will be able to migrate to a safe habitat if climate change adversely affects their present one. 'Green corridors' between protected areas and buffer zones around them will be important, along with good management of areas between core protected areas.

This is the thinking behind Natura 2000, a network of protected areas in Europe. This kind of broad 'mosaic landscape' based approach requires a bold partnership between government, businesses (including farm and forestry businesses), landowners and non-governmental organisations to deliver the best social, economic and environmental benefits possible.

Pro-poor, biodiversity-friendly mitigation

Forest conservation, afforestation and reforestation Rising concerns over climate change and a growing market for carbon offer opportunities to link climate change mitigation with biodiversity conservation. But many of the proposals to date have paid scant attention to biodiversity conservation or the world's poor.[10] The Clean Development Mechanism (CDM), established under the Kyoto Protocol of the UNFCCC, is supposed to provide global benefits from carbon sequestration as well as sustainable development benefits to developing countries. Most projects, however, have been designed without these development benefits in mind.

Proposals to use carbon finance to conserve large areas of forested land, and so reduce greenhouse gas emissions from deforestation, rarely provide forest-dependent communities with access to either carbon finance or forest resources. For the poor, the benefits of reforestation and afforestation projects are also unclear because they may have used the land for other purposes and are unlikely to have the skills and capital to take part in such projects themselves. While large-scale monoculture plantations may be effective carbon sinks, their biodiversity benefits are minimal and they are more vulnerable to pest attacks, which could cause the loss of the trees planted. If the reforestation project replaces native grassland, wetland, shrub- or heathland, dramatic biodiversity losses may result while leaving any boost in carbon sequestration open to question.[11]

Forest conservation, reforestation, afforestation and agroforestry projects, such as the N'hambita Community Carbon Project in Mozambique (see Box 3), can potentially help mitigate climate change, support local livelihoods, provide biodiversity benefits and restore watershed functions. Forest management activities such as increasing forest rotation age, harvesting to emulate natural disturbance regimes and avoiding fragmentation can simultaneously provide biodiversity and climate change mitigation benefits. Afforestation or reforestation can establish 'green corridors' and boost biodiversity significantly if a variety of native tree species of different ages are planted.

Box 3 Out of the woods: the N'hambita Community Carbon Project

In Mozambique's Sofala province, a project is afoot that successfully meets the multiple demands of community, biodiversity and the battle against climate change. The N'hambita Community Carbon Project, a 1469-hectare site in a buffer zone of the Gorongoso National Park, aims to restore degraded areas and promote sustainable land use via a number of methods. These include good forest management, reforestation, promoting nitrogen-fixing trees, and the production of non-timber forest products such as traditional medicine, fruits and fungi. Sedentary agriculture is replacing slash and burn.

Under the project, some 230,000 trees and 120 kilometres of firebreaks have been planted to date. Some 70 per cent of the N'hambita community have been involved, with each farmer owning 0.7 to 1.8 hectares of land. The project promotes sound governance and community participation in decision-making through representation on the project management team.

Funding comes from the sale of carbon credits in the voluntary carbon market. The funds are shared among participating individuals and some are put in a community trust fund for projects such as school construction. Other benefits include sustainable generation of timber and fuel wood, good watershed management, soil conservation and enhancement of other ecosystem services. Yields of traditional maize and sorghum crops have increased by use of nitrogen-fixing food crops such as pigeon pea.

Local people have also diversified their livelihoods, taking on enterprises ranging from beekeeping and micro-irrigation for cultivating vegetables to carpentry and bioenergy production for schools and the community. Farmers have been trained in tree planting and protection, micro-enterprise and fire management. Land use rights are being clarified and better defined. At the same time, regional organisations are also being trained to verify carbon offsets, administer trust funds and provide land management support.

Source: www.miombo.org.uk

Energy Use of renewable energy sources provides an opportunity to reduce emissions from burning fossil fuels. The Brazilian ethanol programme provides fuel for more than 5 million cars each year. It has created 720,000 jobs directly and 200,000 indirectly in rural areas, curbed city air pollution and avoided 6 to 10 million tonnes of carbon emissions per year since 1980, according to 2003 figures.[12]

But elsewhere, the benefits of biofuels are less apparent. Indonesia has some 6 million hectares of land under oil palm and the government supports further expansion. If this goes ahead, up to 50 billion tonnes of carbon are likely to be released into the atmosphere — the equivalent of over six years of global fossil fuel burning. Land clearance for plantations will accelerate the destruction of peatlands, which are important carbon stores. Due to peatland destruction, every tonne of palm oil produced in Southeast Asia results in up to 33 tonnes of CO_2 emissions — 10 times that produced by burning an equivalent volume of petroleum. The expansion of plantations also reduces food security because it means less land is available for food crops. Biofuel production threatens biodiversity. The habitat that has proven most suitable for oil palm planting in most areas is lowland evergreen tropical rainforest, which supports the highest biodiversity of any terrestrial ecosystem.[13]

Large-scale renewable energy schemes, such as hydropower dams, can also negatively affect biodiversity and local livelihoods. In Southeast Asia, plans to build scores of dams with massive hydroelectricity generating potential on the Mekong River will affect the livelihoods of the 52 million people currently using river resources, many of whom live below the poverty line. Dam construction will prevent fish migration, and yet fish provide 40 to 60 per cent of the animal protein consumed by people in the lower Mekong basin. The nine largest dam projects alone would displace 60,000 rural people.[14]

The way forward Biodiversity and ecosystem services are the foundation of many successful adaptation strategies, especially for poor people. They can also deliver climate change mitigation benefits. Many of the best solutions to climate change, such as the International Small Group and Tree Planting Program (see Box 4) provide multiple benefits — for biodiversity, poverty alleviation, and adaptation and mitigation. But meeting all these objectives can be difficult. Adaptation activities in one sector can compromise those in another, as well as mitigation, biodiversity or poverty objectives. Decisions should therefore be based on good science and an understanding of these trade-offs. At the very least, climate change solutions should aim to avoid damaging biodiversity and ecosystem services, and increasing inequity and poverty.

In southwestern China, a participatory plant breeding project has provided multiple benefits by supporting farmers' innovation and adaptation processes, biodiversity and livelihoods (see Box 5). Similarly, an agreement between the International Potato Centre in Peru and Andean farmers is helping to deliver a range of benefits. Hundreds of lost potato varieties are being returned to the Potato Park, an area that protects rich potato diversity along with the rights of farmers to access and use them. By supporting traditional farming systems with lower greenhouse gas emissions, these initiatives are also providing mitigation benefits.

Governments, individuals, bilateral organisations and the private sector need to do more joined-up thinking to ensure that initiatives that meet the objectives of the MDGs, the UNFCCC and the CBD are supported. Currently, however, the bodies responsible for each convention, and the governments and ministers in charge of implementing them, tend to have a sectoral approach, focusing on their own objectives. The UK Department for International Development, for example, has recently announced it is giving £50 million to the government of the Democratic Republic of Congo for avoided deforestation activities. But with funding going directly to the Congolese government, it is unclear whether the communities that live in and rely on the forest land in question will either benefit from such funds or even retain their access to forest resources.

While big infrastructure projects can be effective, comparatively little attention has been paid to non-structural alternatives and to 'bottom-up' approaches rooted in existing community-based strategies for managing resources and reducing vulnerability to climatic shocks. Working with nature is often cheaper than engineered solutions, as Box 2 amply illustrates. Adaptation activities in particular should

Box 4 Growing success: the International Small Group and Tree Planting Program

The International Small Group and Tree Planting Program (TIST) may have started small, but its massive growth since 1999 is a testament to the multiple-benefit approach to adaptation and mitigation. Initiated by the Anglican church that year in Mpwapwa, Tanzania, TIST supports small groups of subsistence farmers in tackling deforestation and climate change-related drought and famine. It began with just 40 groups in one region of Tanzania, but has since grown to over 2800 groups in Kenya, Uganda and India as well. Over 2.3 million trees have been planted.

TIST strategies include small group development, conservation farming and sustainable agriculture, reforestation, agroforestry and entrepreneurship involving the sale of carbon offsets and farm products. Activities also address health, education and nutrition. Local subsistence farmers are involved in planning, implementation and information sharing. The aim is to empower and equip them to restore their natural environment, increase soil fertility, create jobs, strengthen local economic development in the local community, and move from famine to surplus.

Carbon offsets from tree planting are sold through eBay and operate under the voluntary market because the complex regulations of the Clean Development Mechanism market make it much tougher to enter. Income from carbon offsets allows local subsistence farmers to buy seeds, care for trees and buy necessities such as medication and school fees. Palmheld computers and Global Positioning System technologies are used to collect information on tree growth and carbon storage, which is shared via the internet by local people trained as auditors and quantifiers. Small cash stipends for every living tree are then deposited regularly into bank accounts opened by small community groups designated for this purpose. Additional benefits include erosion prevention, soil improvement, and the provision of windbreaks, timber, medicine, bee habitats, natural insecticides and fencing material. Local biodiversity is also conserved.

Source: www.tist.org

take account of local knowledge because poor people have had to cope with climate variability for many years. While large projects have political appeal and provide an 'easy fix', the biodiversity, climate change and poverty benefits of small-scale activities may be many times greater.

Climate change in one sense provides an opportunity to make a shift towards more resilient ways of using land and benefiting poor people. Small-scale projects such as the case studies featured here need to be scaled up and multiplied to encourage the direction of large-scale funding towards local solutions. Such funding must come from carbon finance, which is increasingly available, but also from public coffers in recognition of the global and multiple benefits that conservation can yield. This, in turn, requires good governance at local, national and international levels to ensure that the projected benefits actually materialise.

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Box 5 Selective partnerships: participatory plant breeding and adaptation in China

The last 13 years have been tough for Guangxi in China's southwest. The province has been hit by higher temperatures, water stress, more unpredictable drought and flooding, and a rise in plant pests and disease. These kinds of changes have led to an erosion of diversity and a rise in absolute poverty in China and other countries — but not in six Guangxi communities. There, formal breeders have joined forces with farmers, supporting local innovation and adaptation processes to tackle the problems through participatory plant breeding (PPB) and community based natural resource management (CBNRM).

The project's overall goal is to link two breeding systems — the farmers' and the government's — through PPB for crop improvement, biodiversity enhancement and farmer empowerment. It builds on farmers' perspectives and traditional knowledge of maize selection and breeding developed over generations, and involves the expertise of formally trained plant breeders. It also promotes biodiversity conservation on farms.

And the combination is working. PPB has helped increase the number and type of genetic varieties and brought in more diversified cropping systems. It has improved a number of farmer-developed and external varieties, from which farmers have selected around 15. These are showing better adaptive characteristics, such as drought resistance and stress tolerance. Overall, collaboration between farmer and researcher has produced added value that each alone could never realise.

Source: Song, Y., Li, J., Huan, Y. and Vernooy, R.

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See also:
Natura 2000 www.natura2000benefits.org

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